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Bank market power, factor reallocation, and aggregate growth☆

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ABSTRACT

Using a unique firm-level sample of approximately 700,000 firm-year observations of German small and medium-sized enterprises (SMEs), this study seeks to identify the effect of bank market power on aggregate growth components. We test for a pre-crisis sample whether bank market power spurs or hinders the reallocation of resources across informationally opaque firms. Identification relies on the dependence on external finance in each industry and the regional demarcation of regional banking markets in Germany. The results show that bank markups spur aggregate SME growth, primarily through technical change and the reallocation of resources. Banks seem to need sufficient markups to generate the necessary private information to allocate financial funds efficiently.

1. Introduction

Does bank market power help or hinder the growth of informationally opaque firms? If they help, how do banks influence the growth of such firms: by enabling them to grow more productive or by aiding more productive firms in their efforts to grow? The exact role of banks in firm growth has been largely ignored in prior research, which is surprising, considering financial intermediaries' responsibilities for selecting productive projects and monitoring borrowers. Both theoretical arguments and empirical outcomes highlight that the effect of bank market power on firm growth is ambiguous (Petersen and Rajan, 1995; Zarutskie, 2006; Canales and Nanda, 2012; Cetorelli and Strahan, 2006; Berger et al., 2007). Banks with market power may hinder growth if they can extract rents from existing lending relationships. The ability to lock in firms may also remove incentives for banks to finance more productive new entrants (Cetorelli and Gambera, 2001; Cetorelli and Strahan, 2006). Market power may be particularly problematic for small and medium-sized enterprises (SMEs), which tend to be informationally opaque and rely more on bank funding (Petersen and Rajan, 1995; Zarutskie, 2006). Yet if bank market power is too low, banks' incentives to generate information about borrowers may diminish (Marquez, 2002), which could lead to resource misallocations

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because banks generate insufficient information to identify the most productive firms (Dell'Ariccia and Marquez, 2004). Similarly, if intense competition prevents banks from extracting rents from firms' innovative investments, they may not lend to such innovators (Petersen and Rajan, 1995).

In response to these ambiguous predictions, we make an initial attempt to distinguish the effects of bank market power on technical change (firms growing more productive) and on resource allocations (growth by more productive firms) (Beck et al., 2000; Carlin and Mayer, 2003; Kerr and Nanda, 2009). The lack of empirical evidence about the importance of resource reallocation among firms for aggregate growth (Basu and Fernald, 2002; Hsieh and Klenow, 2009; Basu et al., 2009; Syverson, 2011) appears largely due to the very high data demands, including comprehensive firm-level information that is rarely available for non-listed corporations, such as SMEs.

To overcome this challenge, we analyze the effect of bank market power using a novel data set of approximately 100,000 informationally opaque SMEs in Germany between 1996 and 2006, which we combine with supervisory data from all banks in Germany. We estimate the extent to which aggregate growth is due to input growth, technical change, and resource reallocation. To identify the relationship between bank market power and growth components, we exploit the regional demarcation of banking markets in Germany, together with the difference in the structural dependence of firms on external finance across industries (Rajan and Zingales, 1998; Claessens and Laeven, 2005; Friedrich et al., 2013). In extending country-industry-level studies, we apply this difference-in-difference approach to explain industry-region-specific output components generated from firm-level data. That is, we use region-specific banking market power indicators obtained at the bank level and industry-specific dependence on external finance (Rajan and Zingales, 1998).

In addition to distinguishing between the effects of bank market power on technical change and on resource reallocation, we use our firm- and bank-level data to investigate differences in effects for more and less opaque SMEs and for different types of banks (i.e., commercial, savings, and cooperative banks). Our within-country setting eliminates concerns about controlling sufficiently for cross-country differences of financial systems and institutions (Claessens and Laeven, 2005).

We find that bank market power significantly increases SME growth by stimulating both technical change and resource reallocation. An increase of Lerner indices by 1 percentage point increases aggregate SME output growth by around 0.1%, at the median level of industry dependence on external finance. The increase can be attributed approximately equally to faster technical change and greater reallocation. We find several indications that growth effects are largest for less opaque firms. For SMEs in industries that depend substantially on external finance, we find insignificant growth effects in response to increasing bank markups. Overall, banks require a minimum level of markups to generate useful private information, which they can use for an efficient selection and risk monitoring, which ultimately leads to growth. Triple interaction effects across market power and the regional bank market structure further show that the positive growth effects of bank market power differ, conditional on the concentration of regional markets. This finding corroborates prior studies, which show that market structure and market power correlate, but reflect different aspects of competition. For our pre-crisis sample of German SMEs, the reallocation component of growth is significant only in response to increasing bank markups when markets are also highly concentrated. This result supports theories that emphasize the importance of sufficiently large customer pools, together with stable bank margins as prerequisites for the generation of private information that is crucial for efficient lending choices.

The remainder of this article is organized as follows: Sections 2 and 3 present the data and method to estimate and decompose output growth. We discuss the main results in Section 4, conduct robustness checks in Section 5, and conclude in Section 6.

2. Sample and data

The data comprise a proprietary sample of corporate clients of German savings banks. This data set has been used previously (Behr et al., 2013; Gropp et al., 2014). It contains the financial accounts of all corporate firms that applied for a loan at a German savings bank between 1996 and 2006. We consider only firms with at least three available balance sheets and exclude all firms with less than two consecutive years of data, in which some production information is missing, or for which labor expenses or material costs are greater than sales. We also leave out firms from the mining industry, because of large outliers, and exclude two regions, namely two urban centers that are geographically not adjacent and that host most of Germany's multinational enterprises. We winsorize, at the 1st and 99th percentiles of all production function variables, to control for any remaining outliers. The sample is unique in providing good coverage of very small firms for which financial accounts typically are not available, though they account for a substantial share of total output in the German economy. The average (median) firm sales are slightly less than € 5 million (€ 1 million). Thus, according to the EU's definition of SMEs, almost 65% of our sample consists of micro firms (up to € 2 million sales), another 25% are small firms (up to € 10 million sales), and a further 8% are medium-sized firms (up to € 50 million sales). Only 2% of the firms in the sample are large. In terms of industry, 25% of the firms are in manufacturing, 25% are construction firms and 50% are in services, mostly business services such as accountants or lawyers (see Table 1). The final data set comprises 696,119 observations between 1996 and 2006. In terms of total output, the SMEs in our sample account for approximately one-seventh of German gross domestic product.

The left panel in Table 1 depicts the mean and standard deviation of the output, production factor, and intermediate factor growth variables. The large dispersion in output and factor growth across firms, even within each industry, illustrates the potential importance of the reallocation of resources from unproductive to productive firms. Mean growth rates further emphasize the importance of cross-industry variation in terms of growth and dependence on external finance (right side in Table 1). This summary of the firm-level data, stratified by industry, bodes well for our approach of explaining cross-regional growth differences by industry and regional banking market traits and the industry need for external financing.

3. Identification and estimation method

3.1. Identification

To identify the effect of regional differences in banking competition on SME growth by industry, we follow the strategy suggested by Rajan and Zingales (1998) and subsequently pursued by, for example, Claessens and Laeven (2005), Kroszner et al. (2007) and Friedrich et al. (2013).

The first identifying assumption is that dependence on external finance differs across industries for structural reasons. We measure the equilibrium dependence on external finance (*ED*) using Compustat data for U.S. firms, because we assume that they face the lowest financing constraints. Similar to Rajan and Zingales (1998), we define *ED* to equal capital expenditures less cash flow from operations divided by capital expenditure. This measure gauges the share of investment that is not financed through retained earnings.

Table 1
Descriptive statistics per industry.
Notes: This table provides descriptive statistics for firms' (log) sales, capital, labor, and material expenditures per industry (first panel). The sample comprises 696,119 observations (197,934 firms) for 11 years between 1996 and 2006. The second part shows output growth ($\Delta \ln Y$), growth of input factors ($\Delta \ln X$), technical change ($\Delta \ln A$), and the reallocation components ($\Delta \ln R$) on the industry level for the period 1996–2006. *N* and *Firms* denote each industry's sample share of industry-year and firm-year observations, respectively.

	Production function components Mean/SD				Industry growth components Mean/SD in %					Share of:	
	$\ln Y$	$\ln L$	$\ln K$	$\ln M$	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$	*ED*	*N*	*Firms*
Agriculture	0.91	0.21	0.83	0.44	0.72	−0.02	0.58	0.16	−0.01	0.0398	0.0483
	2.88	0.57	1.91	1.81	3.32	5.96	1.75	4.41	1.17		
Food products	7.48	1.38	1.66	4.21	1.67	1.47	0.53	−0.33	−0.42	0.0387	0.0342
	17.57	2.86	4.30	11.27	4.41	4.61	2.09	2.79	0.53		
Textiles, apparel &leather	9.78	2.22	1.48	5.55	0.10	−1.66	0.70	1.07	−0.94	0.0086	0.0080
	17.06	3.65	3.50	10.26	9.37	11.03	4.59	6.60	1.17		
Wood products	4.21	0.95	0.86	2.40	3.08	0.22	1.53	1.32	−0.27	0.0175	0.0163
	10.12	2.02	2.66	6.25	12.36	15.53	5.96	12.13	0.66		
Paper, printing &publishing	7.10	1.92	1.61	3.40	0.94	0.58	0.16	0.19	−0.73	0.0218	0.0206
	15.62	3.64	4.39	8.70	3.79	4.11	1.89	2.93	0.56		
Chemical products	14.22	3.06	2.83	7.38	0.73	0.39	0.40	−0.06	4.20	0.0052	0.0051
	22.75	4.66	5.96	13.09	1.71	2.89	1.21	2.74	1.57		
Rubber &plastics	8.90	2.29	1.88	4.57	3.07	2.49	0.78	−0.20	−0.11	0.0164	0.0147
	14.98	3.42	4.15	8.66	5.78	5.39	2.36	3.08	0.44		
Stone, clay &glass	6.32	1.65	1.84	2.96	0.66	0.25	0.59	−0.18	−0.22	0.0145	0.0136
	12.88	3.20	4.46	6.45	6.27	6.57	3.19	4.82	0.48		
Metal products	5.43	1.58	1.17	2.64	2.54	1.09	0.99	0.46	−0.21	0.0603	0.0556
	12.19	2.99	3.21	7.07	5.52	4.29	2.84	3.34	0.64		
Machinery	8.90	2.59	1.44	4.39	1.55	0.93	0.49	0.12	0.07	0.0307	0.0305
	16.18	4.09	3.77	9.01	4.09	3.31	2.32	2.07	0.76		
Electrical &electronic equipment	6.38	1.80	0.93	3.13	1.67	0.76	0.70	0.21	0.97	0.0318	0.0304
	14.24	3.45	3.08	7.90	4.73	6.17	1.88	4.56	0.60		
Transport equipment	13.14	3.11	2.85	7.53	0.66	0.51	0.28	−0.13	0.08	0.0066	0.0070
	22.46	4.95	6.78	13.65	1.67	2.12	0.96	1.69	0.32		
Miscellaneous manufacturing	6.07	1.51	1.14	3.11	1.53	−1.11	0.56	2.09	−0.41	0.0166	0.0160
	12.97	2.93	3.06	7.61	9.71	9.57	5.36	7.61	0.84		
Utilities	25.11	3.21	17.29	15.24	0.49	0.22	0.04	0.23	−0.14	0.0024	0.0033
	29.41	4.54	14.75	18.62	2.65	2.64	1.63	1.40	0.20		
Construction	2.29	0.73	0.31	1.15	0.46	0.23	0.52	−0.30	1.17	0.1952	0.1889
	5.94	1.54	1.23	3.53	4.39	2.85	2.90	1.40	0.57		
Motor vehicle trade	6.46	0.70	0.73	5.00	7.14	5.69	1.91	−0.46	0.31	0.0889	0.0822
	12.31	1.59	2.06	9.17	11.27	10.93	5.25	5.28	0.63		
Wholesale trade	10.22	1.11	0.90	7.49	4.09	3.06	2.32	−1.29	0.37	0.0956	0.0928
	18.69	2.33	2.77	13.26	7.30	7.36	3.34	4.01	1.16		
Retail trade	3.57	0.61	0.51	2.31	0.85	0.83	0.11	−0.10	0.10	0.1344	0.1367
	11.42	2.12	2.69	7.30	2.63	4.32	1.48	3.84	0.46		
Hotels &restaurants	0.87	0.27	0.53	0.25	0.38	−1.02	0.12	1.28	0.03	0.0595	0.0601
	3.11	0.83	1.53	1.43	2.09	2.97	1.03	2.54	0.24		
Transport &storage	5.07	1.27	1.50	2.31	1.11	0.58	0.60	−0.07	0.05	0.0353	0.0361
	11.04	2.51	4.35	6.77	2.12	2.81	1.61	2.10	0.21		
Telecommunications	6.18	1.24	2.30	3.39	0.44	0.34	0.19	−0.09	0.13	0.0011	0.0015
	15.32	2.75	7.19	9.64	1.31	1.14	0.85	0.63	0.46		
Business services	5.05	1.10	4.07	2.42	−0.31	0.11	−0.17	−0.26	0.82	0.0791	0.0980
	12.93	2.59	10.13	7.55	2.63	2.97	2.11	1.59	0.98		

Cash flows are the sum of the operational cash flow plus increases in inventories and payables, less decreases in receivables. Unlike the United States, Germany's financial structure resembles a bank- rather than a market-based system (Beck and Levine, 2002). Therefore, the mean industry *ED* derived from Compustat firm-level data may be a poor proxy for the equilibrium needs for external funding in Germany. Thus, we also use debt-to-asset ratios based on data from the Amadeus database for firms in Germany, France, and the United Kingdom (Fernández de Guevara and Maudos, 2011).

We aggregate the firm-level data by region ($r = 1, \ldots, 67$) and industry ($j = 1, \ldots, 22$) in each year ($t = 1996, \ldots, 2006$). We then regress industry output growth and its components (total input growth, factor reallocation, and technical change) V_{rjt} on dependence on external finance (*ED*) in industry *j* and the average Lerner indices (*LI*), which is a measure for bank market power, for each region *r* in a difference-in-difference setting:

$$V_{rjt} = a_r + a_j + a_t + b_1 ED_{jt} + b_2 LI_{rt} + b_3 (ED_{jt} \times LI_{rt}) + \epsilon_{rjt}. \quad (1)$$

We assume that dependence on external finance differs across industries for structural reasons. If bank market power fosters growth, industries with greater *ED* should grow at different rates than in regions with less competitive banking markets, after controlling for industry-region and time-specific effects.

This identification strategy exploits two particularities of our sample of German SMEs and banks. First, it is a reasonable assumption that the SMEs in our sample – all of which are customers of regional savings banks and active in one of the 22 industries in the EU KLEMS database (O'Mahony and Timmer, 2009) – are active in only one of the 67 regional markets defined by the German Savings and Loan Association. Second, the vast majority of German savings and cooperative banks do not serve customers outside their region by self-imposed regulation; commercial banks also operate mostly in regionally confined markets, except for the largest four (German Council of Economic Experts, 2013). Therefore, it is a reasonable assumption that market power in one region does not determine market power in another region. Within regions, SMEs also turn to different banks to demand financial services. For a similar time period, Popov and Rocholl (2014) report for a sample of roughly 38,000 German SMEs that the average firm maintains relationships with two banks. In our sample 10% of firms even bank with four or more financial institutions. Therefore, we consider differences in average market power between regional markets and the (weighted) average growth of industries within these regional markets.[1]

Table 2 provides the summary statistics of the variables specified in Eq. (1); in the remainder of this section we explain how to obtain the data for aggregate growth Y, its three components, the Lerner index LI as a measure of market power, and the Herfindahl index HHI a measure of regional bank market structure.

3.2. Output growth decomposition

Firms can grow by increasing their inputs or through technical change. From the overall economy perspective, it also matters which firms grow. If more resources are allocated to firms with high marginal products relative to marginal costs, aggregate output in the economy expands (Basu et al., 2009). Therefore for firm i at time t, we measure output as sales Y, labor as L, capital as K, materials and other intermediate inputs as M, and technology as A. Firm technology is represented by the output elasticity β of each input. We specify for each industry j a Cobb-Douglas production function and use the Wooldridge (2009) GMM variant of the Levinsohn and Petrin (2003) estimator to account for simultaneity of factor demand and productivity at the firm-level.

$$\ln Y_{it|j} = \beta_{0j} + \beta_j^L \ln L_{it|j} + \beta_j^K \ln K_{it|j} + \beta_j^M \ln M_{it|j} + \epsilon_{it|j} \quad \text{for each} \quad j = 1, \ldots, 22. \tag{2}$$

To aggregate firm-level dynamics to industry growth (components), we estimate Eq. (2) for each of the 22 industries in Table 1. Columns (1)–(3) describe the firm-level data to estimate Eq. (2) for each industry; column (7) shows the measure of each industry's dependence on external finance. Output elasticities are precisely estimated and broadly comparable to the corresponding industry cost shares from EU KLEMS. To conserve on space, we provide the parameter estimates in an online appendix (Table OA 2).[2]

We decompose output growth into the two "conventional" components and a reallocation component (Basu et al., 2009). Thus we gauge the growth of aggregate output in excess of the cost-weighted growth in inputs, which is relevant for welfare. Denoting the cost share of each input by c, and omitting subscripts for industries j, we decompose firm output growth as follows:

$$\begin{aligned}\Delta \ln Y_{it} = \; & \Sigma_k c_{it}^k \Delta \ln X_{it}^k \\ & + \; \Sigma_k [(\hat{\beta}_{it}^k - c_{it}^k) \Delta \ln X_{it}^k] + \Delta \ln A_{it} \quad \text{for} \quad k = L, K, M.\end{aligned} \tag{3}$$

The first term in Eq. (3) is the contribution of a change in inputs to output growth. The second term compares the marginal product $\hat{\beta}$ estimated in Eq. (2) to the observed marginal cost c of each input. It is a measure of reallocation, because a shift of one unit of input from a low marginal product firm to a high marginal product firm is beneficial for the economy. The third term of Eq. (3) measures the contribution of technical change to output growth.

The growth components in Eq. (3) are all defined at the firm level; in contrast, in Eq. (1) we identified the impact of regional bank market power on industry growth by exploiting between-region differences. To aggregate firm-level growth components to the industry level, we used Domar weights v_{it}, the two-period average ratio of nominal output over aggregate value added.[3] We decompose industry output growth rates into the contributions of total input growth, reallocation, and technical change for each region, omitting the subscripts for regions r, as follows:

$$\Delta \ln X_{jt} = \sum_i v_{it} \left(\sum_j c_{it}^k \Delta \ln X_{it}^k \right), \tag{4a}$$

$$\Delta \ln R_{jt} = \sum_i v_{it} \left(\sum_j \left[(\beta_{it}^k - c_{it}^k) \Delta \ln X_{it}^k \right] \right), \tag{4b}$$

$$\Delta \ln A_{jt} \;=\; \sum_i v_{it} \Delta \ln A_{it}. \tag{4c}$$

Our empirical analysis therefore uses $\Delta \ln Y_{rjt}$, $\Delta \ln X_{rjt}$, $\Delta \ln R_{rjt}$ and $\Delta \ln A_{rjt}$ as dependent variables to estimate Eq. (1).

3.3. Banking market competition

The decomposition in Eqs. (4a)–(4c) is important so that we can identify more granular channels through which banking market competition and structure affect growth. Cetorelli and Strahan (2006) show that less banking market contestability can facilitate factor accumulation at large incumbents, thereby subduing the pace of innovation (technical change), and of reallocation of production factors from low-productivity to high-productivity firms. Although both aspects have been neglected, we focus more on theoretical models that emphasize the potential impact of financial market imperfections on the reallocation of production factors across firms (Aghion et al., 2007; Herrera et al., 2011).

We follow previous studies by Hasan et al. (2009) and Koetter et al. (2012) to estimate the Lerner indices (LI) for the population of German banks. Higher LIs indicate more market power. Detailed financial accounts data come from prudential supervisory accounts made available by Deutsche Bundesbank. The individual measures of market power equal the difference between average revenues and marginal cost, scaled by average revenues. We estimate bank-specific market power metrics for all universal banks, including regional and large commercial, savings, and cooperative banks, using a latent banking technology estimation technique (Greene, 2005). The details about methodology and data are available in the online appendix.

The identification of the parameters b_2 and b_3 in Eq. (1), as a means to explain output growth (component) differences, hinges on an explanation of market power differences across regions. Therefore, we allocate bank-specific Lerner indices to regional markets according to the location of the bank's headquarters. This approach is appropriate, considering that of the 3,368 universal banks that existed in 1996, 607 were regional savings banks and 2,497 were local cooperatives, both of which are obliged to operate only within their region. Only the four large commercial banks, thirteen central savings banks (*"Landesbanken"*), and four central cooperatives operated across regional borders.[4]

Panel (a) of Fig. 1 shows the mean Lerner indices across agglomeration regions in 1996 and 2006, that is the start and end of our sample period. Panel (b) shows regional Herfindahl indices,

[1] We describe the variation across regions in Section 3.3, together with robustness checks to account for nation-wide branching of the largest commercial banks.

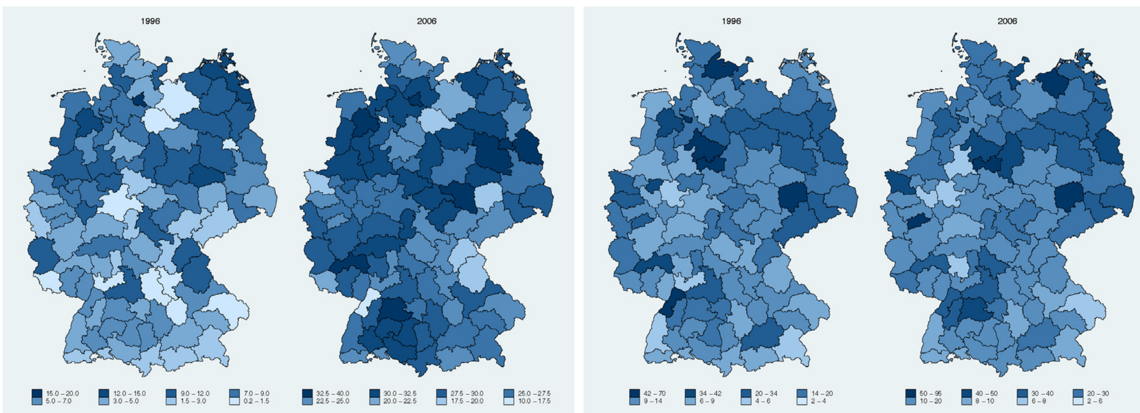
[2] Subsequent regression results are robust to different methods for estimating output elasticities.

[3] We provide details on Domar weights in the online appendix.

[4] We also used the weighting schemes suggested in the annual report of the German Council of Economic Experts (2013), but these did not alter the results qualitatively. A range of alternative spatial allocation schemes of banks to regions, such branch-location weighting, (inverse) distance-decay weighting, or adjacent county weighting across various balance sheet positions, such as customer deposits, loans, and total assets are broadly consistent with rank-order correlations ranging from 75% to 80%.

Table 2
Growth components, dependence on external finance, and bank competition.
Notes: This table shows the descriptive statistics for all variables used to estimate the baseline regression. The sample comprises information for 14,913 observations for 11 years, 22 industries, and 67 regions. ΔlnY is aggregate growth; ΔlnX is input growth; ΔlnR is a reallocation term following Basu et al. (2009); ΔlnA is technical change; *ED* represents industry-specific dependence on external finance calculated with Compustat data for matching U.S. industries over time; *LI* represents Lerner indices net of operational inefficiency for each German region over time. *HHI* represents the Herfindahl index based on banks' total assets for each German region over time.

Variable	Abbreviation	Mean	SD
Output growth	ΔlnY	0.0160	0.0620
Input growth	ΔlnX	0.0078	0.0672
Technical change	ΔlnA	0.0066	0.0306
Reallocation	ΔlnR	0.0016	0.0459
External dependence on finance	*ED*	0.2185	1.2329
Lerner index	*LI*	0.1379	0.0840
Herfindahl index	*HHI*	0.1846	0.1130



(a) Lerner index (b) Herfindahl index

Fig. 1. Market power and concentration across German regions. *Notes*: This figure shows the distribution of *LI* and *HHI* across German regions ("Raumordnungsregionen") for 1996 and 2006. Darker colors in Panel (a) indicate higher levels of market power and more concentrated markets in Panel (b).

measuring the concentration of gross total bank assets.[5] As these maps clearly illustrate, market power varies substantially across regions, as is necessary for identification. In addition, both market power and market concentration increased substantially over time (see also Figure OA1 in the online appendix; German Council of Economic Experts, 2013). Deciding on the best measure of competition in the banking industry remains a topic of debate (Carbó-Valverde et al., 2009a), so we also specify a measure of the regional banking market structure based on concentration. We use the Herfindahl index of total bank assets. The use of loans or deposits, instead of total assets, did not affect the results below.

4. Results

4.1. Baseline

We estimate Eq. (1), using as dependent variables industry output growth ($\Delta \ln Y$) and growth components, namely input growth ($\Delta \ln X$), technical change ($\Delta \ln A$), and resource reallocation ($\Delta \ln R$), to establish the effect of bank market power. Table 3 shows the baseline results for a sample of 14,913 region-industry observations from 1996 to 2006. We report standard errors clustered at the region-industry level. Clustering by region-year or industry-year does not affect the results. The explanatory power for output growth in the first column is an adjusted R^2 of 15%, which is rather high in a panel regression context. The R-squared value for the technological change regression (10%) is reasonable. The values are relatively low for the factor accumulation and reallocation specifications.

The direct effects of both bank market power and dependence on external finance are significantly positive for output growth, technical change and reallocation. In line with Beck et al. (2000) and Carlin and Mayer (2003) we find an insignificant effect on factor accumulation as a source of output growth. The differential effect of bank market power at different levels of external dependence is significantly negative for aggregate output growth, technical change, and reallocation.

As Brambor et al. (2006) caution though, we need to evaluate the (total) conditional marginal effect in interaction models to assess the effect of market power on growth components. The derivative of Eq. (1) with respect to growth (components) depends on the level of dependence on external finance. Therefore, we follow Law and Singh (2014) and Lessmann (2014) and present the effect of market power on growth (components) at the 5th, 25th, 50th, 75th, and 95th percentile of the *ED* distribution in the bottom panel of Table 3.

These conditional marginal effects are more informative than the point estimates of the coefficients. Even when the point estimates of the coefficients are insignificant at the mean of the variable, marginal effects at other points of the *ED* distribution may be statistically significant. This is illustrated in Fig. 2, which shows the total marginal effects of *LI* on $\Delta \ln Y$, $\Delta \ln X$, $\Delta \ln A$ and $\Delta \ln R$ across the distribution of *ED*. Because we base the figure on the parameter estimates of Eq. (1) we account for the heterogeneity of external funding needs in each industry.

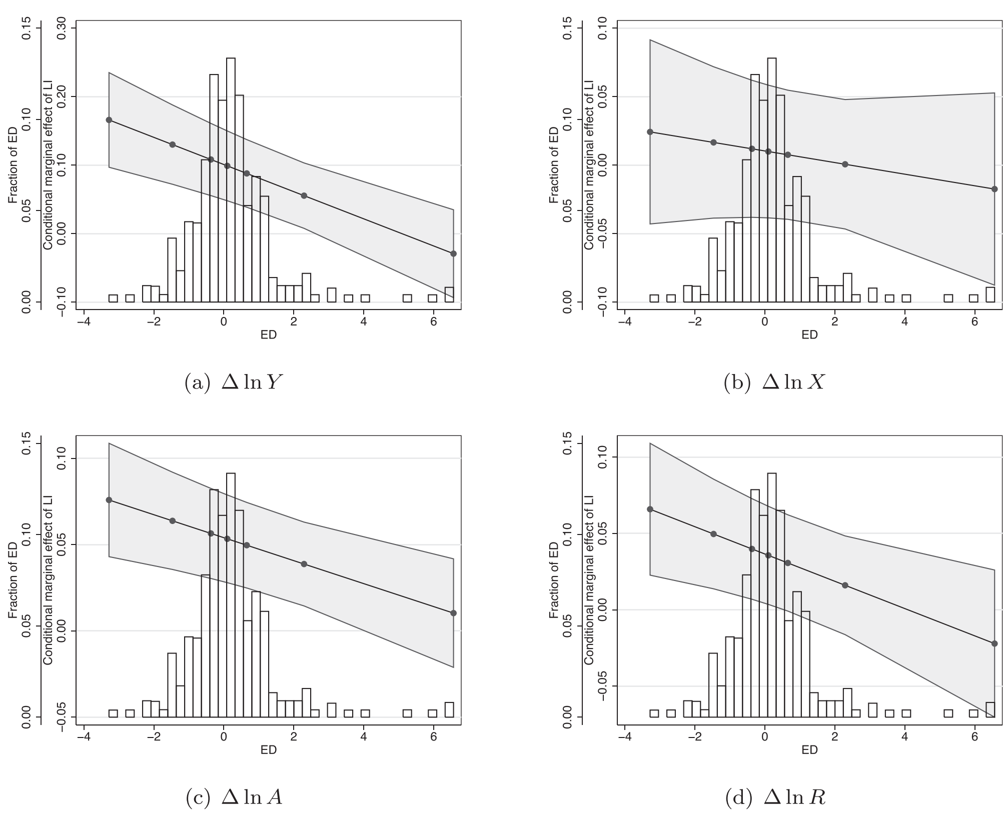
For this sample of SMEs, bank market power spurs aggregate industry growth significantly. An increase of the average Lerner indices by 1 percentage point increases output growth by 0.13% for the least dependent sectors. An increase of market power by one

[5] We include aggregate data for 96 agglomeration areas ("Raumordnungsregionen") rather than the 67 regions defined by the German Savings and Loan Association that we use in the regression analysis, for confidentiality reasons.

Table 3
Aggregate growth components and Lerner indices.
Notes: This table shows the baseline regression results for 14,913 observations for 11 years, 22 industries, and 67 regions. Fixed effects identifying each region, industry, and years are included but not reported. ΔlnY is aggregate growth; ΔlnX is input growth; ΔlnR is a reallocation term; ΔlnA is technical change; *ED* represents industry-specific dependence on external finance calculated with Compustat data for matching U.S. industries over time; *LI* represents Lerner indices net of operational inefficiency for each German region over time. The bottom panel depicts marginal effects conditional on different levels of *ED*, ranging from the 5th to the 95th percentile. Clustered standard errors by region-industry are in parentheses. ***, ** and * indicate statistically significant coefficients at the 1%, 5%, and 10% levels, respectively.

Dependent variable	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$
LI	0.1009***	0.0103	0.0540***	0.0365**
	(0.0262)	(0.0249)	(0.0130)	(0.0165)
ED	0.0066***	0.0021	0.0011*	0.0035***
	(0.0013)	(0.0014)	(0.0006)	(0.0010)
LI × ED	−0.0198***	−0.0042	−0.0067***	−0.0089***
	(0.0048)	(0.0052)	(0.0022)	(0.0034)
Constant	−0.0164***	0.0048	−0.0083***	−0.0128***
	(0.0055)	(0.0049)	(0.0019)	(0.0022)
Fixed effects				
Industry	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes
Time	Yes	Yes	Yes	Yes
Observations	14913	14913	14913	14913
Adjusted *R*-squared	0.1580	0.0678	0.1034	0.0397
Marginal effect of *LI* conditional on *ED* percentiles				
5th(ED)	0.1299***	0.0165	0.0638***	0.0496***
	(0.0296)	(0.0282)	(0.0144)	(0.0183)
25th(ED)	0.1082***	0.0119	0.0565***	0.0398***
	(0.0269)	(0.0255)	(0.0133)	(0.0168)
50th(ED)	0.0989***	0.0099	0.0533***	0.0356***
	(0.0260)	(0.0247)	(0.0130)	(0.0164)
75th(ED)	0.0878***	0.0075	0.0496***	0.0307*
	(0.0252)	(0.0241)	(0.0127)	(0.0161)
95th(ED)	0.0554**	0.0006	0.0387***	0.0160
	(0.0244)	(0.0241)	(0.0124)	(0.0165)

standard deviation, from 13.8% to 22.2%, would increase industry growth by 0.9%. In light of average output growth of 1.6%, these effects are economically significant. The effect is smaller, though, for industries that depend more heavily on external finance. Panel (a) of Fig. 2 illustrates that the total marginal effects of increasing bank market power become insignificant for industries with very high levels of dependence on external finance, though this setting accounts for relatively few observations. Panels (b) and (c) in Fig. 2,



(a) $\Delta \ln Y$ (b) $\Delta \ln X$

(c) $\Delta \ln A$ (d) $\Delta \ln R$

Fig. 2. Total marginal effects of LI conditional on ED. *Notes*: This figure shows marginal effects of *LI* on $\Delta \ln Y$, $\Delta \ln X$, $\Delta \ln A$ and $\Delta \ln R$ conditional on the distribution of *ED*. The 95% confidence interval is indicated by the shaded area. The distribution of *ED* is plotted by bars and the fractions are reported on the second *y*-axis.

as well as the corresponding total marginal effects in Table 3, show that factor accumulation does not significantly respond to changes in banking market competition across the entire *ED* distribution while technological change does so across almost the entire range of *ED*.

The positive effect of bank market power on output growth (components) initially appears to contradict the findings of Cetorelli and Gambera (2001) and Claessens and Laeven (2005) of a negative relation between banking market concentration measures and industry growth across countries. To reconcile these results, we note that industry growth in our study refers to the growth of SMEs, rather than all firms in an industry. In that sense, our findings match those of Zarutskie (2006), who finds that increasing banking market competition leads to stiffer financing constraints and less investment for small, private U.S. firms (see also Carbó-Valverde et al., 2009b). Cetorelli and Gambera (2001) report that young firms, which tend to be small, actually benefit from increasing banking market concentration. Our results, based on (generally more opaque) SMEs, are thus not contradictory to earlier findings but they rather affirm that different types of firms are affected differently by bank market power.

Another important difference involves the reallocation component, which other studies omit. The last column of Table 3 shows that technological change and reallocation contribute similarly to aggregate output growth. At the median level of dependence on external finance, an increase of market power by 1 percentage point increases technological change by 0.06%, and the reallocation effect across SMEs amounts to a sizeable 0.04%. Therefore, it appears that one of the key intermediation functions fulfilled by banks, namely to screen and identify the most promising SMEs, is executed more effectively if banks can realize reasonable markups. A positive effect of market power on the reallocation component of SME growth is in line with theoretical banking studies that show how the increasing contestability of banking markets leads to a deterioration of loan quality, because banks generate less information (Marquez, 2002; Dell'Ariccia and Marquez, 2004; Hauswald and Marquez, 2006). The last column in Table 3 and Panel (d) in Fig. 2, consistently show that growth due to reallocation becomes insignificant when dependence on external finance exceeds the 75th percentile of the *ED* distribution. This effect is in line with studies that show how banks reap monopoly rents after locking-in credit-constrained customers (Degryse and Ongena, 2005; Berger et al., 2007; Carbó-Valverde et al., 2009b), such as those SMEs that depend most heavily on bank financing.

4.2. Market power, market structure, or both?

We measure bank market power in each region according to the markups earned by all German banks to which SMEs can turn for credit. In so doing, we assess the notion proposed by Boone (2008) that the (non-)competitive conduct of banks depends on the contestability of a market. Most prior studies instead consider the concentration of national or regional banking markets using market shares or Herfindahl indices (Bikker and Bos, 2008). Yet market structure and market power may exert different effects on growth and growth components. Furthermore, Germany is among the least concentrated banking markets in Europe (Cetorelli and Gambera, 2001; Claessens and Laeven, 2005; Cetorelli and Strahan, 2006; Carbó-Valverde et al., 2009a; Fernández de Guevara and Maudos, 2010).

To test if the difference in competition measures drives our results, Table 4 provides the estimates when we specify the Herfindahl index on the basis of mean asset market shares per region.

Qualitatively, the total marginal effects of concentration in the bottom panel of Table 4 are similar to the main findings we obtained with the regional averages of Lerner indices. Higher concentration, conventionally interpreted as an indication of more market power, spurs aggregate growth through technological change and reallocation. The magnitude of these effects is somewhat lower than in the baseline results, but overall these outcomes are in line with Petersen and Rajan (1995) and Zarutskie (2006) who document that the effect of bank market power on growth is positive. The cost of powerful banks extracting rents from locked-in customers thus seems outweighed in our SME sample by the gains from the generation of better private information about opaque borrowers by banks. In line with Cetorelli and Gambera (2001), we find that the positive effect of bank market power on SME growth declines with increasing dependence on external financing.

Although market structure and market power are correlated, the differences in total marginal effects also indicate that they measure different concepts (Bikker and Bos, 2008). Furthermore, the conditional marginal effect of monopoly power on external financial dependence also might vary according to the market structure – a conjecture analogous to the changing relationship between a bank's market power and risk taking, modeled by Martinez-Miera and Repullo (2010). For example, the benefits of bank market power for the growth of less dependent industries may be amplified in concentrated markets when average customer pools are even larger, which enhances the quality of private information to financial intermediaries as in Hauswald and Marquez (2003, 2006). Alternatively, powerful banks in regions with very few potential contestants may start to extract rents even from relatively less dependent industries, as proposed in Rajan (1992).

To investigate the potential interaction between the regional bank market structure and bank market power, we specify a triple interaction term, in Eq. (5):

$$V_{rjt} = a_r + a_j + a_t + b_1 ED_{jt} + b_2 LI_{rt} + b_3 HHI_{rt} + b_4 (ED_{jt} \times LI_{rt}) + b_5 (ED_{jt} \times HHI_{rt}) + b_6 (LI_{rt} \times HHI_{rt}) + b_7 (ED_{jt} \times LI_{rt} \times HHI_{rt}) + \epsilon_{rjt}. \tag{5}$$

The according results are in Table 5. We again draw inference on the basis of the conditional marginal effects that reflect the total effect of parameters b_1 through b_7 in Eq. (5) because of the changes in *HHI* and *LI* at different levels of dependence on external finance.

The three panels in Table 5 show marginal effects, evaluated at different levels of *ED*, ranging from the 5th to the 95th percentile, at three points in the market structure distribution, corresponding to the 10th, 50th and 90th percentile of the *HHI* distribution, as mapped in Panel (b) of Fig. 1.

Aggregate output growth and technological change, across all three levels of regional banking market concentration, exhibit the previously documented positive effects. The contribution of factor accumulation to output growth remains insignificant across the entire *ED* distribution in all three panels. The total marginal effects of output growth and technological change decline somewhat as *HHI* increases, yet the differences between the three market structure panels are not statistically significant across *ED*. That is, an increase in banks' markups continues to spur growth for every level of external financial dependence.

For the reallocation component, the important qualitative difference is that there is no significant positive growth effect in the least concentrated markets, i.e., the 10th percentile of the *HHI* distribution. In banking markets at the median level of concentration, reallocation increases growth only for firms in the least financially dependent industries and this effect is weakly significant at best. The bottom panel shows that an increase in the economic margins of banks stimulates growth broadly when the regional market is also among the most concentrated. The marginal effects for output growth, technical change, and reallocation are all statistically significant and positive at the 1% level. Only firms in the most

Table 4
Banking concentration.
Notes: This table shows the regression results for 14,913 observations for 11 years, 22 industries, and 67 regions. Fixed effects identifying each region, industry, and years are included but not reported. ΔlnY is aggregate growth; ΔlnX is input growth; ΔlnR is a reallocation term; ΔlnA is technical change; *ED* represents industry-specific dependence on external finance calculated with Compustat data for matching U.S. industries over time; *HHI* represents the Herfindahl index based on banks' total assets for each German region over time. The bottom panel depicts marginal effects conditional on different levels of *ED*, ranging from the 5th to the 95th percentile. Clustered standard errors by region-industry are in parentheses. ***, ** and * indicate statistically significant coefficients at the 1%, 5%, and 10% levels, respectively.

Dependent variable	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$
HHI	0.0329***	−0.0159	0.0231***	0.0256***
	(0.0102)	(0.0099)	(0.0054)	(0.0065)
ED	0.0032***	0.0014	−0.0003	0.0021***
	(0.0009)	(0.0011)	(0.0004)	(0.0007)
HHI × ED	−0.0028	−0.0010	0.0002	−0.0020
	(0.0032)	(0.0032)	(0.0015)	(0.0019)
Constant	−0.0250***	0.0117*	−0.0155***	−0.0212***
	(0.0071)	(0.0065)	(0.0029)	(0.0035)
Fixed effects				
Industry	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes
Time	Yes	Yes	Yes	Yes
Observations	14913	14913	14913	14913
Adjusted *R*-squared	0.1569	0.0679	0.1031	0.0398
Marginal effect of *HHI* conditional on *ED* percentiles				
5th(ED)	0.0370***	−0.0144	0.0228***	0.0286***
	(0.0109)	(0.0100)	(0.0054)	(0.0065)
25th(ED)	0.0339***	−0.0155	0.0230***	0.0264***
	(0.0102)	(0.0100)	(0.0054)	(0.0065)
50th(ED)	0.0326***	−0.0160	0.0231***	0.0254***
	(0.0102)	(0.0098)	(0.0054)	(0.0065)
75th(ED)	0.0310***	−0.0165	0.0232***	0.0243***
	(0.0106)	(0.0111)	(0.0063)	(0.0065)
95th(ED)	0.0264**	−0.0182	0.0236***	0.0210***
	(0.0130)	(0.0120)	(0.0054)	(0.0072)

dependent industries exhibit no statistical reallocation component effect.

These results therefore suggest that the growth-enhancing effects of market power in banking are amplified in the most concentrated regional banking markets. This finding is consistent with theoretical explanations by Hauswald and Marquez (2003, 2006) that emphasize the detrimental effects of small customer pools for banks in unconcentrated markets, such that they dilute banks' abilities to generate private information and in turn foster credit misallocation (Dell'Ariccia and Marquez, 2004).

4.3. *Time-varying versus constant* ED

Our identification strategy differs from several previous studies (Rajan and Zingales, 1998; Claessens and Laeven, 2005; Kroszner et al., 2007; Dell'Ariccia et al., 2008; Körner and Schnabel, 2011; Friedrich et al., 2013), in that we use a time-varying measure of *ED*. The *ED*s provide a sort of industry equilibrium in the dependence on external finance and also can filter out time-, country-, and industry-specific effects. To account for these rationales and show that our results do not hinge on the assumption of time-varying *ED*s, we conduct two robustness checks.

First, we add additional fixed effects that cover time-varying industry effects and combined industry-region effects. These dummies absorb all effects that vary between industries and over time and that those vary between industries and regions at the same time. Therefore, *ED* can no longer be included separately. Table 6 shows that the explanatory power of all four specifications increases accordingly, with adjusted R^2 ranging between 22% for the factor accumulation and reallocation specifications and 29% for the variance share of the aggregate output growth explained by the regression.

Our previous baseline results are not significantly affected by the inclusion of additional fixed effects. Thus, the limited explanatory power we reported previously appears to be of little concern. The economic significance is slightly higher, indicating that a 1 percentage point increase in *LI* leads to a 0.11% increase in output growth for an industry characterized by a median *ED* level. Higher levels of bank market power lead to higher output growth, once more driven by technical change and a better allocation of resources among SMEs within industries. The positive effect of bank's market power on reallocation is only present at higher levels of *ED*.

Second, to account for time-varying effects, we aggregate the data across all years and provide the results in Table 7. In this specification, we do not use any fixed effects, which would exclude *ED*, *LI* and the interaction term from the regression, because *ED* only varies between industries, *LI* varies only between regions, and the combined fixed effects vary in the same dimension as the interaction effect. However, we cluster the standard errors again along the industry-region level. The results in Table 7 corroborate our main findings: a higher level of bank's market power spurs growth by fostering technical change and factor allocation between industries.

4.4. *Benchmark for equilibrium dependence on external finance*

Our use of U.S. firms to determine the equilibrium level for external dependence may spark concerns associated with the distinct corporate capital structure of continental European firms (von Fürstenberg and von Kalckreuth, 2006). In a traditionally bank- rather than market-based financial system, the role of external funding sources likely differs (see Beck and Levine, 2002). Therefore, we follow Fernández de Guevara and Maudos (2011) and specify additional *ED* benchmarks using UK firms, French firms, and observed German firms' external dependence indicators in Table 8.

All three benchmarks confirm the main findings: larger regional markups by German banks spur aggregate output growth. Except for industries that depend most on external finance, this positive effect of market power on growth appears to work through technological change and reallocation. Thus, it seems irrelevant whether we rely on market- or bank-based systems to provide the benchmark for equilibrium dependence on external finance.

Table 5
Aggregate growth components, Lerner indices and banking concentration.
Notes: This table shows the regression results for interactions of *LI*, *ED* and *HHI* for 14,913 observations for 11 years, 22 industries, and 67 regions. Fixed effects identifying each region, industry, and years are included but not reported. ΔlnY is aggregate growth; ΔlnX is input growth; ΔlnR is a reallocation term; ΔlnA is technical change; *ED* represents industry-specific dependence on external finance calculated with Compustat data for matching U.S. industries over time; *LI* represents Lerner indices net of operational inefficiency for each German region over time. The bottom panel depicts marginal effects conditional on different levels of *ED*, ranging from the 5th to the 95th percentile and the 10th, the 50th, and the 90th percentile of *HHI*, respectively. Clustered standard errors by region-industry are in parentheses. ***, ** and * indicate statistically significant coefficients at the 1%, 5%, and 10% levels, respectively.

Dependent variable	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$
LI	0.0885***	0.0318	0.0418***	0.0150
	(0.0292)	(0.0283)	(0.0139)	(0.0169)
ED	0.0087***	0.0047**	0.0015*	0.0025*
	(0.0017)	(0.0020)	(0.0008)	(0.0014)
LI × ED	−0.0300***	−0.0195**	−0.0095**	−0.0011
	(0.0083)	(0.0094)	(0.0039)	(0.0061)
LI × ED × HHI	0.0534	0.0775**	0.0144	−0.0385
	(0.0403)	(0.0390)	(0.0188)	(0.0255)
HHI	0.0212*	−0.0029	0.0138**	0.0103
	(0.0118)	(0.0118)	(0.0057)	(0.0070)
LI × HHI	0.0490	−0.0907	0.0470	0.0926**
	(0.0812)	(0.0639)	(0.0402)	(0.0422)
ED × HHI	−0.0108	−0.0134*	−0.0019	0.0046
	(0.0080)	(0.0075)	(0.0035)	(0.0044)
Constant	−0.0251***	0.0075	−0.0144***	−0.0182***
	(0.0071)	(0.0067)	(0.0028)	(0.0034)
Fixed effects				
Industry	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes
Time	Yes	Yes	Yes	Yes
Observations	14913	14913	14913	14913
Adjusted *R*-squared	0.1583	0.0679	0.1041	0.0402
Marginal effect of *LI* conditional on *ED* percentiles and *HHI*				
10th(HHI):				
5th(ED)	0.1305***	0.0460	0.0574***	0.0270
	(0.0320)	(0.0322)	(0.0149)	(0.0194)
25th(ED)	0.1017***	0.0306	0.0482***	0.0229
	(0.0282)	(0.0277)	(0.0134)	(0.0169)
50th(ED)	0.0894***	0.0240	0.0442***	0.0211
	(0.0269)	(0.0263)	(0.0130)	(0.0162)
75th(ED)	0.0747***	0.0162	0.0395***	0.0190
	(0.0257)	(0.0251)	(0.0126)	(0.0157)
95th(ED)	0.0317	−0.0067	0.0257**	0.0128
	(0.0249)	(0.0253)	(0.0127)	(0.0169)
50th(HHI):				
5th(ED)	0.1281***	0.0297	0.0595***	0.0390**
	(0.0296)	(0.0291)	(0.0140)	(0.0183)
25th(ED)	0.1040***	0.0211	0.0515***	0.0314*
	(0.0269)	(0.0262)	(0.0130)	(0.0167)
50th(ED)	0.0937***	0.0174	0.0481***	0.0282*
	(0.0260)	(0.0252)	(0.0127)	(0.0162)
75th(ED)	0.0814***	0.0130	0.0440***	0.0244
	(0.0252)	(0.0245)	(0.0124)	(0.0159)
95th(ED)	0.0454*	0.0002	0.0321***	0.0131
	(0.0243)	(0.0244)	(0.0123)	(0.0164)
90th(HHI):				
5th(ED)	0.1217***	−0.0153	0.0652***	0.0718***
	(0.0386)	(0.0330)	(0.0194)	(0.0228)
25th(ED)	0.1104***	−0.0052	0.0607***	0.0549***
	(0.0327)	(0.0285)	(0.0165)	(0.0201)
50th(ED)	0.1056***	−0.0009	0.0588***	0.0477**
	(0.0309)	(0.0273)	(0.0156)	(0.0195)
75th(ED)	0.0999***	0.0043	0.0565***	0.0392**
	(0.0294)	(0.0265)	(0.0148)	(0.0191)
95th(ED)	0.0831***	0.0193	0.0497***	0.0141
	(0.0304)	(0.0290)	(0.0145)	(0.0208)

5. Further robustness checks

5.1. Firm size

The effect of banking market competition on aggregate industry growth depends in general on the degree of information asymmetry that banks must resolve. Black and Strahan (2002) and Canales and Nanda (2012) show that smaller and younger firms, which are more opaque, face more stringent financing constraints in less competitive banking markets. Whereas our available data does not include information about the age of the firms, an important feature of this sample is that the vast majority of firms are very small SMEs. More than half of them are micro firms, according to the EU taxonomy with sales or total assets are less than € 2 million, and less than ten employees. Around 88% of them are either micro or small enterprises with less than € 10 million in

Table 6
Aggregate growth components and Lerner indices: interacted fixed effects.
Notes: This table shows the regression results for 14,913 observations for 11 years, 22 industries, and 67 regions. Fixed effects identifying each region, industry, pair of region and industry, years, and year-industry pairs are included but not reported. ΔlnY is aggregate growth; ΔlnX is input growth; ΔlnR is a reallocation term; ΔlnA is technical change; *ED* represents industry-specific dependence on external finance calculated with Compustat data for matching U.S. industries over time; *LI* represents Lerner indices net of operational inefficiency for each German region over time. The bottom panel depicts marginal effects conditional on different levels of *ED*, ranging from the 5th to the 95th percentile. Clustered standard errors by region-industry are in parentheses. ***, ** and * indicate statistically significant coefficients at the 1%, 5%, and 10% levels, respectively.

Dependent variable	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$
LI	0.1151***	0.0284	0.0623***	0.0244
	(0.0273)	(0.0284)	(0.0131)	(0.0183)
LI × ED	−0.0221	−0.0192	−0.0126*	0.0098
	(0.0148)	(0.0179)	(0.0070)	(0.0106)
Constant	−0.0073	−0.0305***	−0.0097***	0.0329***
	(0.0048)	(0.0066)	(0.0018)	(0.0053)
Fixed effects				
Industry	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes
Time	Yes	Yes	Yes	Yes
Industry × Region	Yes	Yes	Yes	Yes
Industry × Time	Yes	Yes	Yes	Yes
Observations	14913	14913	14913	14913
Adjusted *R*-squared	0.2894	0.2145	0.2321	0.2189
Marginal effect of *LI* conditional on *ED* percentiles				
5th(ED)	0.1475***	0.0565*	0.0808***	0.0101
	(0.0410)	(0.0325)	(0.0142)	(0.0158)
25th(ED)	0.1232***	0.0355	0.0669***	0.0208
	(0.0299)	(0.0325)	(0.0192)	(0.0206)
50th(ED)	0.1129***	0.0265	0.0610***	0.0254
	(0.0268)	(0.0274)	(0.0129)	(0.0177)
75th(ED)	0.1006***	0.0158	0.0539***	0.0308*
	(0.0252)	(0.0344)	(0.0124)	(0.0158)
95th(ED)	0.0644*	−0.0156	0.0332**	0.0468**
	(0.0344)	(0.0238)	(0.0169)	(0.0215)

Table 7
Aggregate growth components and Lerner indices: aggregated annual sample.
Notes: This table shows the regression results after aggregating the original sample (14,913 observations for 11 years, 22 industries, and 67 regions) to the industry-region dimension. ΔlnY is aggregate growth; ΔlnX is input growth; ΔlnR is a reallocation term; ΔlnA is technical change; *ED* represents industry-specific dependence on external finance calculated with Compustat data for matching U.S. industries over time; *LI* represents Lerner indices net of operational inefficiency for each German region over time. The bottom panel depicts marginal effects conditional on different levels of *ED*, ranging from the 5th to the 95th percentile. Clustered standard errors by region-industry are in parentheses. ***, ** and * indicate statistically significant coefficients at the 1%, 5%, and 10% levels, respectively.

Dependent variable	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$
LI	0.1151***	0.0284	0.0623***	0.0244
	(0.0273)	(0.0284)	(0.0131)	(0.0183)
LI × ED	−0.0221	−0.0192	−0.0126*	0.0098
	(0.0148)	(0.0179)	(0.0070)	(0.0106)
Constant	−0.0073	−0.0305***	−0.0097***	0.0329***
	(0.0048)	(0.0066)	(0.0018)	(0.0053)
Fixed effects				
Industry	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes
Time	Yes	Yes	Yes	Yes
Industry × Region	Yes	Yes	Yes	Yes
Industry × Time	Yes	Yes	Yes	Yes
Observations	14913	14913	14913	14913
Adjusted *R*-squared	0.2894	0.2145	0.2321	0.2189
Marginal effect of *LI* conditional on *ED* percentiles				
5th(ED)	0.1475***	0.0565*	0.0808***	0.0101
	(0.0410)	(0.0325)	(0.0142)	(0.0158)
25th(ED)	0.1232***	0.0355	0.0669***	0.0208
	(0.0299)	(0.0325)	(0.0192)	(0.0206)
50th(ED)	0.1129***	0.0265	0.0610***	0.0254
	(0.0268)	(0.0274)	(0.0129)	(0.0177)
75th(ED)	0.1006***	0.0158	0.0539***	0.0308*
	(0.0252)	(0.0344)	(0.0124)	(0.0158)
95th(ED)	0.0644*	−0.0156	0.0332**	0.0468**
	(0.0344)	(0.0238)	(0.0169)	(0.0215)

sales or total assets and no more than 49 employees. Less than 2% of the sample consists of large corporations with more than 249 employees and € 50 million (€ 43 million) in sales (total assets).

Table OA4 in the online appendix shows estimation results of Eq. (1), in which we aggregate firm-level data (for each industry-region and year) separately for micro firms and non-micro firms. Not all regions host firms from all size groups in all years, so the number

Table 8
Alternative *ED*s.
Notes: This table shows the regression results for 14,913 observations for 11 years, 22 industries, and 67 regions. Fixed effects identifying each region, industry, and years are included but not reported. ΔlnY is aggregate growth; ΔlnX is input growth; ΔlnR is a reallocation term; ΔlnA is technical change; *ED* represents industry-specific dependence on external finance calculated with Amadeus data for matching U.K. industries (first part), French industries (second part), and German industries (third part) over time; *LI* represents Lerner indices net of operational inefficiency for each German region over time. The bottom panel depicts marginal effects conditional on different levels of *ED*, ranging from the 5th to the 95th percentile. Clustered standard errors by region-industry are in parentheses. ***, ** and * indicate statistically significant coefficients at the 1%, 5%, and 10% levels, respectively.

	ED for UK industries				*ED* for French industries				*ED* for German industries			
Dependent variable	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$	$\Delta \ln Y$	$\Delta \ln X$	$\Delta \ln A$	$\Delta \ln R$
LI	0.3976***	0.0825**	0.1988***	0.1163***	0.2214***	-0.0060	0.1097***	0.1177***	−0.1139**	−0.0107	−0.0646***	−0.0386
	(0.0491)	(0.0413)	(0.0228)	(0.0269)	(0.0353)	(0.0328)	(0.0174)	(0.0216)	(0.0478)	(0.0479)	(0.0218)	(0.0287)
ED(UK)	0.0526	0.2718***	−0.0542**	−0.1649***								
	(0.0444)	(0.0475)	(0.0231)	(0.0261)								
LI × ED(UK)	−0.9049***	−0.2206***	−0.4387***	−0.2457***								
	(0.0989)	(0.0849)	(0.0433)	(0.0561)								
ED(FR)					0.0116	0.1049***	0.0295*	−0.1228***				
					(0.0319)	(0.0393)	(0.0172)	(0.0305)				
LI × ED(FR)					−0.5337***	0.0638	−0.2437***	−0.3538***				
					(0.0792)	(0.0794)	(0.0385)	(0.0513)				
ED(GE)									−0.0431**	−0.0588***	−0.0009	0.0166
									(0.0176)	(0.0194)	(0.0080)	(0.0104)
LI × ED(GE)									0.4606***	0.0413	0.2581***	0.1611***
									(0.1017)	(0.1051)	(0.0464)	(0.0622)
Constant	−0.0303*	−0.0845***	0.0112	0.0430***	−0.0123	−0.0306**	−0.0147**	0.0329***	0.0031	0.0259***	−0.0058	−0.0170***
	(0.0156)	(0.0162)	(0.0078)	(0.0087)	(0.0122)	(0.0142)	(0.0063)	(0.0103)	(0.0086)	(0.0089)	(0.0037)	(0.0044)
Fixed effects												
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14913	14913	14913	14913	14913	14913	14913	14913	14913	14913	14913	14913
Adjusted R-squared	0.1628	0.0690	0.1108	0.0418	0.1585	0.0679	0.1049	0.0407	0.1578	0.0685	0.1056	0.0399
Marginal effect of *LI* conditional on *ED* percentiles												
5th(ED)	0.1705***	0.0271	0.0887***	0.0546***	0.1285***	0.0052	0.0673***	0.0560***	0.0084	0.0003	0.0040	0.0042
	(0.0296)	(0.0268)	(0.0145)	(0.0176)	(0.0272)	(0.0255)	(0.0135)	(0.0169)	(0.0285)	(0.0273)	(0.0136)	(0.0174)
25th(ED)	0.1367***	0.0189	0.0724***	0.0455***	0.1191***	0.0063	0.0630***	0.0498***	0.0583***	0.0047	0.0319***	0.0216***
	(0.0274)	(0.0255)	(0.0135)	(0.0168)	(0.0266)	(0.0251)	(0.0133)	(0.0166)	(0.0251)	(0.0237)	(0.0124)	(0.0157)
50th(ED)	0.1091***	0.0122	0.0590***	0.0380***	0.1036***	0.0081	0.0559***	0.0395***	0.1120***	0.0096	0.0620***	0.0404***
	(0.0259)	(0.0246)	(0.0129)	(0.0163)	(0.0258)	(0.0246)	(0.0129)	(0.0163)	(0.0266)	(0.0255)	(0.0133)	(0.0169)
75th(ED)	0.0658***	0.0016	0.0380***	0.0262***	0.0839***	0.0105	0.0469***	0.0265***	0.1426***	0.0123	0.0792***	0.0511***
	(0.0241)	(0.0238)	(0.0121)	(0.0159)	(0.0251)	(0.0242)	(0.0126)	(0.0160)	(0.0296)	(0.0290)	(0.0147)	(0.0189)
95th(ED)	−0.0364	−0.0233	−0.0116	−0.0015	0.0017	0.0203	0.0094	−0.0280	0.1659***	0.0144	0.0922***	0.0593***
	(0.0234)	(0.0247)	(0.0115)	(0.0166)	(0.0257)	(0.0263)	(0.0129)	(0.0173)	(0.0327)	(0.0323)	(0.0160)	(0.0208)

of observations is less than in the baseline specification in Table 3. The coefficients for micro firms do not confirm the positive effects of either *LI* and *ED* or the negative differential effect. The conditional marginal effects of micro firm output growth in the left panel are also insignificant. Therfore, we find little evidence to support the conjecture that banks with market power lock in credit constrained customers to extract rents (Rajan, 1992). Still, we also do not find any evidence that larger markups in banking benefit the smallest firms in the economy.

The right panel of Table OA4 shows instead that larger, less opaque firms drive the positive growth effect from larger bank market power. The marginal effects for the decomposition are less significant due to the reduced variation when we aggregate over the subsamples of micro and non-micro firms. The result that technological change requires some market power of banks is confirmed fairly strongly, though. Sufficient profitability buffers in the banking industry thus appear necessary to finance riskier investments that lead to technological advances. Reallocation is only significant at the 10% level for the lowest dependence on external finance. It is thus the reallocation of resources across micro and non-micro firms, rather than the optimal allocation of resources within these size categories, that matters for aggregate industry growth.

5.2. Soft information

We also investigate the effect of market power conditional on the amount of “soft” information provided by banks. An essential advantage attributed to banks in the SME lending literature is their ability to extract soft information from their credit relationships (Berger et al., 2001). For a subset of around 15,000 SMEs per year between 2002 and 2005 in our sample, we observe firms’ ratings as determined by the bank, and investigate if credit officers add any soft information that might change the overall firm rating from the financial rating, based solely on financial accounts data provided by credit applicants.

Table OA5 indicates no evidence of significantly different growth responses to changes in bank market power for aggregate growth (components) across firms with and without soft information. Yet this likely reflects the drastically smaller sample size for firms with available rating information, rather than a providing strong evidence contrary to the relevance of soft information in SME lending.

5.3. Firm risk

We try to gauge more directly the riskiness of firms, which interacts with the market power of banks (Keeley, 1990; Boyd and De Nicolo, 2005; Martinez-Miera and Repullo, 2010) and may induce inefficient lending choices (Dell’Ariccia and Marquez, 2004). To this end, we aggregate firm data across three groups of SMEs. Groups are distinguished according to their Altman Z-score (Altman, 1968). Altman’s Z-score is calculated on the basis of firms’ balance sheet data as the weighted sum of five ratios (with weights in parantetheses): working capital to total assets (1.2), retained earnings to total assets (1.4), earnings before interest and tax to total assets (3.3), equity to liabilities (0.6), and sales to total assets (0.99).

Risky firms are those in the bottom quartile of the Z-score distribution, whose Altman Z-scores are less than 1.69. Stable firms are the 50% of firms that have Z-scores between 1.68 and 4.29; very stable firms are in the top quartile, with Z-scores above 4.3. After controlling for the same fixed effects we discussed previously, we do not find, in Table OA6, any significant effect of market power on growth (components) across different subsamples of industry-region growth (components), aggregated across companies from the three different risk classes.

5.4. Incorporation of firms

In addition to size and riskiness, information asymmetries differ among SMEs, according to their form of incorporation. Private proprietorships ex ante provide less financial information to potential lenders, because they are subject to lighter publication requirements. Ex post, they grant weaker titles to collateral, because they have simpler procedures regulating personal insolvencies. Public incorporation instead implies standardized and frequent publication of financial accounts, stricter legal procedures in case of insolvencies, and minimum capital requirements. As private forms of incorporation, we consider sole proprietorship, private partnerships (Gesellschaft bürgerlichen Rechts), and general partnerships (Offene Handelsgesellschaft). Public incorporations are limited partnerships (Kommanditgesellschaft, Gesellschaft mit beschränkter Haftung), stock companies (Aktiengesellschaft), and combinations thereof (KG. a.A., GmbH & Co KG).

The total marginal effects in Table OA7 for informationally more opaque, privately incorporated SMEs show that an increase in bank market power has a negative effect on aggregate growth for firms that are active in the most dependent sectors of the economy. For public firms the total marginal effects of *LI* on aggregate growth $\Delta \ln Y$ remain significantly positive for most of the *ED* distribution. This positive aggregate growth effect is smaller in magnitude than that for the entire sample, though. According to small business lending literature, banks increasingly rely on standardized rating technologies and thus require financial accounts information for SMEs too (Berger et al., 2007). Public firms are obliged by law to generate and publish such financial data; private firms are not. The prime driver of aggregate growth among public firms in Table OA7 remains technological change. Moreover, factor accumulation becomes significant if dependence on external finance is low. Reallocation is insignificant, again corroborating our finding that the ability of banks to facilitate reallocation across all SMEs, rather than within the group of public SMEs, contributes significantly to growth.

5.5. Market power per banking pillar

We already accounted for the considerable bank heterogeneity documented by Krahnen and Schmidt (2004), because we used a latent-class estimation technique to obtain the market power measures, as we describe in the online appendix. In addition, we consider if market power per banking group exhibits different effects on region-industry growth. Table OA8 shows the total marginal effects across the *ED* distribution when specifying all three regional Lerner indices per banking group and the associated interaction terms jointly.

The overall significance of the total marginal effects deteriorates, which indicates the high collinearity among Lerner indices for specific banking groups. The effects that remain statistically discernible from zero, mostly among the group of commercial banks, provide qualitative confirmation of our main results. Larger markups spur aggregate growth and technological change and, to a lesser extent, the reallocation component of growth. As an exception, we note the negative aggregate growth effects of increasing markups among cooperatives (the smallest banks in Germany) on firms that are most dependent on external finance. Thus, even the smallest banks appear to command some local market power and extract rents, consistent with anecdotal evidence reported by consumer protection agencies that these financial intermediaries charge the highest overdraft interest rates in Germany (Stiftung Warentest, 2013).

A high correlation of the market power measures for each banking group within regions is consistent with the annual report of the German Council of Economic Experts (2013), which suggest that the vast majority of banks operate only locally. Even among privately owned commercial banks, only the very largest maintain branch networks across the entire country. Accordingly, market shares calculated across different regional definitions (states, counties, municipalities) and banking products (loans, deposits, total assets) exhibit very high correlations of up to 80%. Likewise, regional Lerner indices weighted by banks' local branches result in very similar regional indicators of market power and do not alter the relationship with regional growth substantially.

6. Conclusion

We exploit the regional banking market structure prevailing in Germany to identify the effects of bank market power on the aggregate industry output growth of SMEs. To this end, we combine comprehensive SME data with prudential regulatory bank data on market power. The novel SME sample enables us to estimate three different growth components: input growth, technical change, and a term that captures gains from the reallocation of production factors from unproductive to more productive SMEs.

During 1996 to 2006, bank market power enhanced output growth of SMEs at the industry level. A 1 percentage point increase of average bank Lerner indices per region increases aggregate SME output growth by 0.1% at the median level of the industry dependence on external finance. Aggregate output growth is primarily due to technical change, but the reallocation of resources from low- to high-productivity SMEs is economically also significant. Our results suggest that banks require some markups to conduct their selection function in the face of credit risks, which constitutes an important influence of banks on the real economy. This result is robust to various alternative measures of industry dependence on external finance, in terms of both time periods and benchmark countries.

The positive effect of market power on growth and growth components is amplified in markets that are more concentrated. The interaction between market power and market structure shows that reallocation in particular contributes significantly to aggregate output growth only when banks earn margins and operate in concentrated regional markets. This result therefore supports theories that emphasize the importance of sufficient margins and sufficiently large market shares of banks to generate private information necessary for efficient credit allocation.

Finally, our robustness checks for subsamples of firms, differentiated according to various indicators of opacity and risk indicates the weaker significance of bank market power effects on growth overall, such that the consideration of reallocation across all firms, and banking groups, is important for determining significant growth effects.

Overall, reasonable markups in banking were beneficial for regional growth prior to the financial crisis of 2007–2009. They might be necessary to generate the important private information required to support an efficient selection and monitoring of risks and, ultimately, growth. Even small banks can extract rents from locked-in firms that depend heavily on external finance, which hampers their growth. Therefore, regional market conditions should be integrated into antitrust policies, rather than relying solely on considerations of bank size.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.jfs.2015.05.004

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